LA-ICPMS U-Pb carbonate dating based on image mapping

KERSTIN DROST[1]*, JOSEPH A. PETRUS[2], DAVID CHEW[1], JON D. WOODHEAD[2]

[1]Department of Geology, Trinity College Dublin, Dublin 2, Ireland (*correspondence: drostk@tcd.ie)
[2]School of Earth Sciences, The University of Melbourne, Parkville, Australia

Direct U-Pb dating of calcite and other carbonate minerals making up limestones, carbonate veins, speleothems or diagenetic cements has important applications potentially permiting dating of unfossiliferous sedimentary carbonate rocks, ore mineralization events, ancient weathering episodes and diagenetic processes.

Present approaches to U-Pb dating of calcite suffer from large age uncertainties due to low U concentrations and/or high amounts of initial Pb. Additionally, local open system behaviour of the U-Pb system or the presence of different generations of carbonate minerals often hinder the extraction of reliable age information from whole rock or *in situ* micro-analytical data, respectively. To overcome these problems we use an approach of shallow LA-ICPMS rastering to generate U/Pb image maps. These maps can be precisely overlain over other images (e.g., LA-ICPMS elemental maps, photomicro-graphs, SEM images) to link age information to compositional, textural or structural features.

Our analytical setup includes a Photon Machines Analyte Excite laser ablation system coupled via an aerosol rapid introduction system (ARIS) to an Agilent 7900 ICPMS instrument allowing for excellent spatial resolution and short analysis times. Data processing employs Iolite [1] and the recently developed Monocle add-on [2], an interrogation tool for 2D element and isotope maps, which allows the selection and pooling of pixels that meet certain criteria. Pixels on a map can be pooled into "analyses" based on an empirical cumulative distribution function of an element or isotopic ratio (e.g. $^{238}U/^{204}Pb$) to create a spread of U-Pb data on concordia diagrams. Moreover, portions of the sample with elevated detrital components, alteration zones or chemically different generations of carbonate minerals can be identified and rejected by defining exclusion criteria (e.g. Rb<1ppm; Mg/Ca<0.004). Initial results from stratigraphically well constrained Paleozoic limestones and shell fragments yield accurate ages with internal age uncertainties as low as ±1%, confirming the feasability of the technique.

[1] Paton *et al.* (2011) *JAAS* **26**, 2508-2518. [2] Petrus *et al. Chemical Geology,* in revision.